Guide for Air Wall Zone Mixing Measure

Measure Intent

- This measure is meant to provide a simple approximation of zone mixing where the zone boundary doesn't represent a physical wall.
- Typically the "Air Wall" construction In OpenStudio is mainly used if using Radiance for daylighting. For thermal analysis it is modeled as something similar to plywood.
- This measure uses air walls to define where zone mixing should be used instead of conductive heat transfer.

Seed Model Preparation

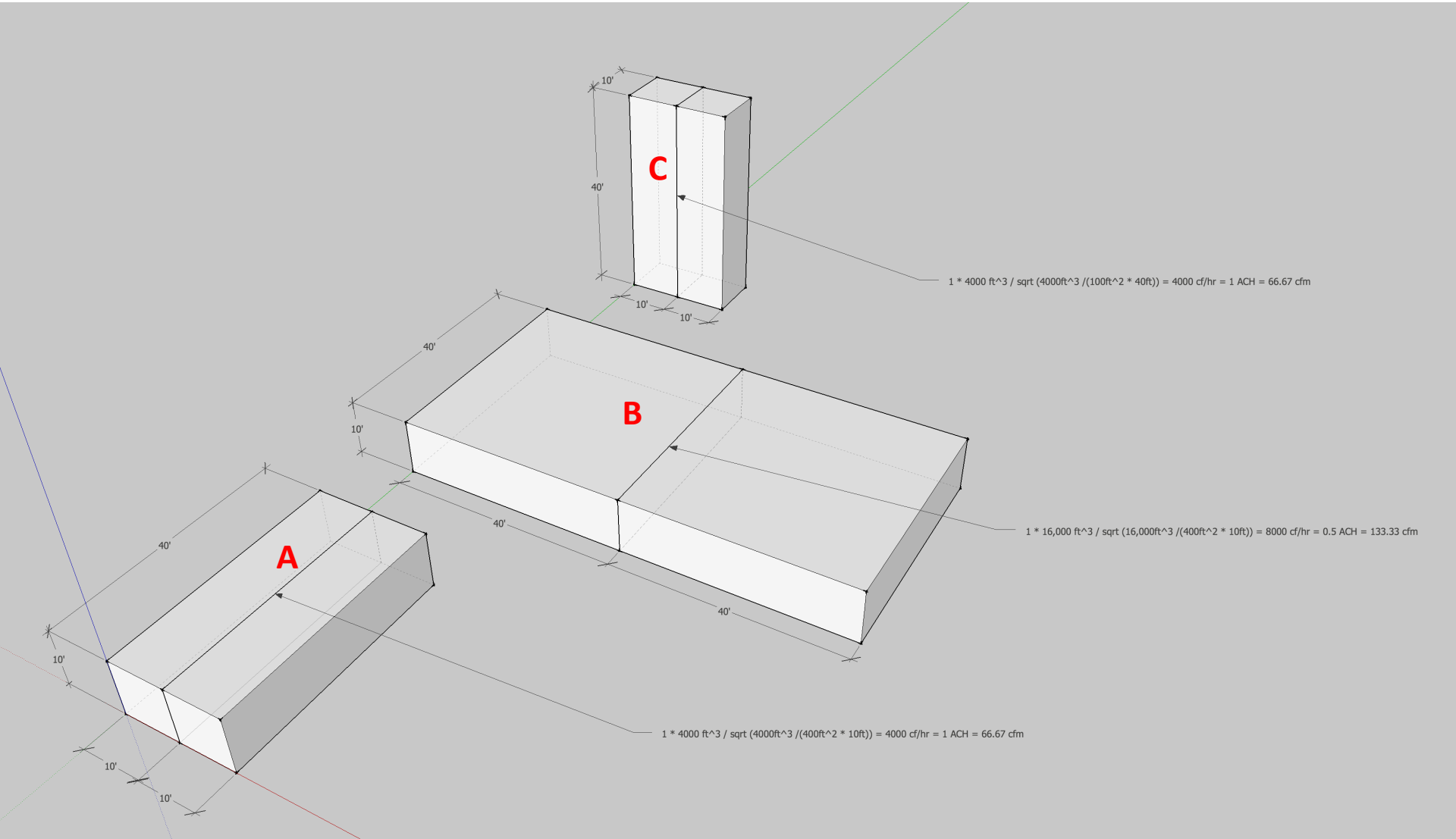
- Create a model with air walls for zone boundaries that don't represent physical walls.
- If you have a core and perimeter model you can just set the construction set default for interior wall to "Air Wall". If not you can manually set just the walls you want by hard assigning constructions.
- You can split a matched wall and make only a portion of it air walls.

How the Measure Works

- The measure works by adding a pair of zone mixing objects between zones with matched wall surfaces using the air wall construction.
- At the same time the boundary condition is changed to adiabatic so there isn't simulation of both conduction and air transfer.
- I simple formula with user adjustable coefficient is provided where the it take 4x the depth of a space given the same opening size to get 2x the CFM of air mixing.
- With a coefficient of 1 a zone that is as deep as it is wide should have a ACH of about 1.

zone mixing coefficient * zone volume/sqrt(zone volume / (air wall area * zone height)

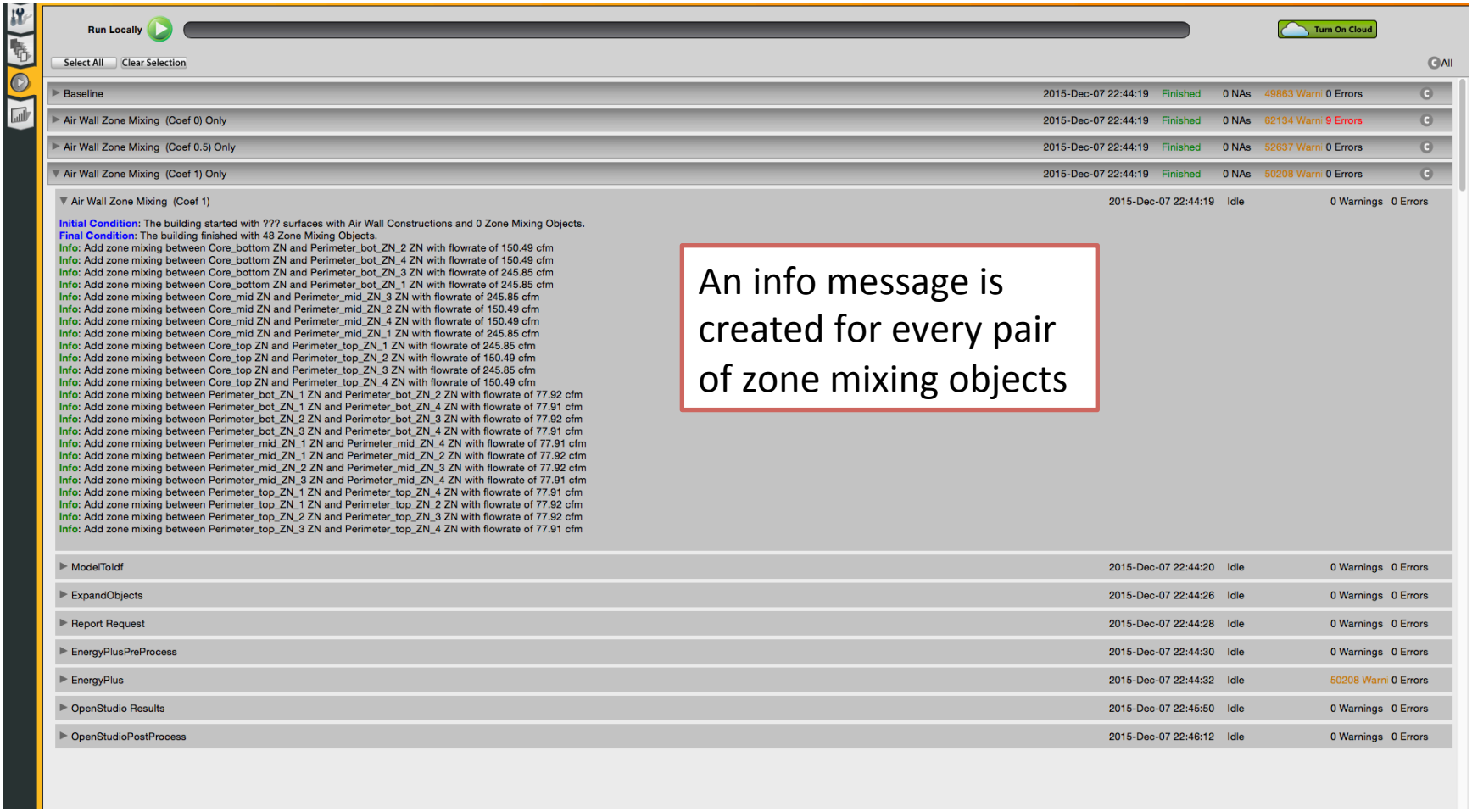
Example diagrams



Example Diagrams

- Notice that in examples A and B the opening area and height is the same. Example B has 4 times the depth, double the total airflow (cfm) yet the ACH value is half of the other example B.
- Example C, which looks like A on its side has the same results as example A.
  - In reality convective effects of a tall space may have a higher mixing rate, but the current measure logic doesn't account for this.

View of Measure Log messages



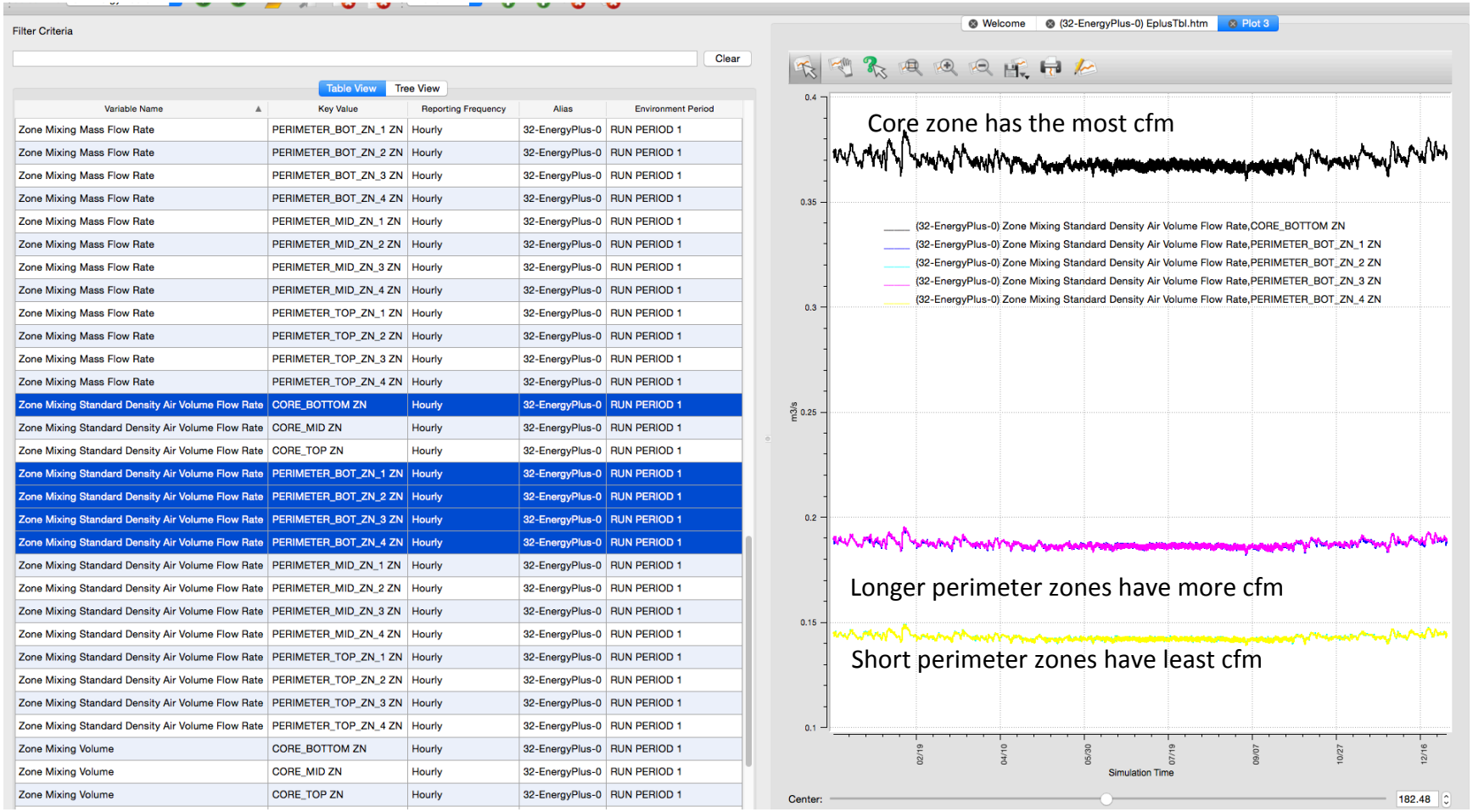
View of Simulation Results

View: Standard | Calibration

Design Alternative Name	Energy Use Intensity (kBtu/ft2-yr)	Peak Electric Demand (kW)	Electricity Consumption (kWh)	Natural Gas Consumption (Million Btu)	District Cooling Consumption (Million Btu)	District Heating Consumption (Million Btu)	First Year Capital Cost ($)	Annual Utility Cost ($)		Total LCC ($)
Baseline	86	395	1,331,150	62	0	0	0	--		0
Design Alternative Name	**Energy Use Intensity Reduction (kBtu/ft2-yr)**	**Peak Electric Demand Reduction (kW)**	**Electricity Savings (kWh)**	**Natural Gas Savings (Million Btu)**	**District Cooling Savings (Million Btu)**	**District Heating Savings (Million Btu)**	**First Year Capital Cost Increase ($)**	**Annual Utility Cost Savings ($)**	**Simple Payback (years)**	**Total LCC Savings ($)**
Air Wall Zone Mixing (Coef 0) Only	(1) (1%)	(26) (7%)	(12,308) (1%)	0 0%	0 --	0 --	0 --	-- --	--	0 --
Air Wall Zone Mixing (Coef 0.5) Only	(0) (1%)	(13) (3%)	(6,972) (1%)	0 0%	0 --	0 --	0 --	-- --	--	0 --
Air Wall Zone Mixing (Coef 1) Only	(0) (0%)	(16) (4%)	(2,228) (0%)	0 0%	0 --	0 --	0 --	-- --	--	0 --
Air Wall Zone Mixing (Coef 2.5) Only	1 1%	(14) (4%)	8,500 1%	0 0%	0 --	0 --	0 --	-- --	--	0 --
Air Wall Zone Mixing (Coef 5) Only	1 1%	(19) (5%)	20,231 2%	0 0%	0 --	0 --	0 --	-- --	--	0 --
Air Wall Zone Mixing (Coef 10) Only	2 2%	(33) (8%)	31,611 2%	0 0%	0 --	0 --	0 --	-- --	--	0 --

- The baseline is medium office prototype building in Houston with conductive inter-zone heat transfer. Other datapoints run this measure resulting in no conductive transfer.
- In this case it appears a coefficient somewhere between 1 and 2.5 gives the most similar results to the baseline.
- The first data point with a coefficient of 0 is equivalent to using adiabatic boundary conditions and no airflow.
- Note how peak load may be impacted more than consumption.

View of Time Series Results



Variable Name	Key Value	Reporting Frequency	Alias	Environment Period
Zone Mixing Mass Flow Rate	PERIMETER_BOT_ZN_1 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_BOT_ZN_2 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_BOT_ZN_3 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_BOT_ZN_4 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_MID_ZN_1 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_MID_ZN_2 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_MID_ZN_3 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_MID_ZN_4 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_TOP_ZN_1 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_TOP_ZN_2 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_TOP_ZN_3 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Mass Flow Rate	PERIMETER_TOP_ZN_4 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	CORE_BOTTOM ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	CORE_MID ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	CORE_TOP ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_BOT_ZN_1 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_BOT_ZN_2 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_BOT_ZN_3 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_BOT_ZN_4 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_MID_ZN_1 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_MID_ZN_2 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_MID_ZN_3 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_MID_ZN_4 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_TOP_ZN_1 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_TOP_ZN_2 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_TOP_ZN_3 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Standard Density Air Volume Flow Rate	PERIMETER_TOP_ZN_4 ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Volume	CORE_BOTTOM ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Volume	CORE_MID ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1
Zone Mixing Volume	CORE_TOP ZN	Hourly	32-EnergyPlus-0	RUN PERIOD 1

Limitations and Known Issues

- The formula used isn't perfect, but was just a rule of them to provide an approximation of airflow across the zone boundary. The goal is to offer an alternative to the conductive transfer that has no airflow across the zone boundary.
- The formula was developed with orthogonal spaces in mind. If you have a diagonal line across a boundary like at the corner it may over estimate the airflow. This is because the formula uses a very simple approach to estimate the depth of a zone by dividing the volume by the opening area.
- Currently the measure just works on walls and not floors. It doesn't account for any convective effects and isn't ideal for a stack of spaces like s stair well.